Impact of Regulating Greenhouse Gas Emissions on US Cattle Industry and Trade Competitiveness

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Man-Keun Kim and Arwin Pang

1. Motivation

- The U.S. is one of major cattle meat exporting countries.
  - In early 2000s the U.S. exported 10% - 12% of the total world cattle meat exports (FAO STAT)
- The U.S. has strong trade competitiveness in the cattle meat export market (revealed comparative advantage (RCA)(Balassa, 1965) was larger than one during 2000-2003).
  - Due to the Bovine Spongiform Encephalopathy (BSE), however, US cattle meat export has decreased dramatically since 2004. Many countries completely banned the import of the cattle meat from the U.S.
- The US livestock industry emitted methane and other greenhouse gases. It emitted 176 Tg CO_2 Eq. in 1990 and 196 Tg CO_2 Eq. in 2005 from enteric fermentation and manure management (more than 95% of methane emissions come from the beef cattle sector)
- Once GHG emissions are regulated (e.g., Methane Capture program), it would be potentially harmful for the cattle meat export since it leads to higher production costs to industry (assuming *pollution haven hypothesis*)
- This research aims to quantify the impact of methane emission regulation on the cattle meat trade competitiveness using the gravity model.

2. Literature Review

- The gravity model of trade was first proposed by Tinbergen (1962). This model explains the international bilateral trade flows between two countries based on their economic sizes and the distance between them. The trade is increasing along with the economic size and decreasing with the distance.
- Bergstrand (1985 and 1989) presented the general equilibrium world trade model to discuss the theoretical foundation of the gravity model. The gravity model has been widely adopted in explaining the effects of trade agreements (Urata and Okabe, 2010; Ekanayake et al, 2010).
- Kim and Koo (2010) analyzes impacts of regulating GHG emission on livestock trade flow and found the negative effect using gravity model.

3. Methods

- The gravity model is used. The equation describing US cattle meat export is given by

$$\ln(EX_{US,j,t}) = \beta_0 + \beta_1 \ln(DIST_{US,j}) + \beta_2 \ln(PROD_{US,t}) + \beta_3 \ln(CNSMP_{j,t}) + \beta_4 \ln(GHG_{US,t}) + \beta_5 \ln(GHG_{j,t}) + \beta_6 D + \varepsilon_{j,t}$$

  - $EX_{us,j,t}$ = value of cattle meat export (US to country j)
  - $DIST_{us,j}$ = distance between US and country j (in km)
  - $PROD_{us,t}$ = value of cattle meat production in US
  - $CNSMP_{j,t}$ = value of cattle meat consumption in country j
  - $GHG_{us,t}$ = methane emissions per dollar of production in US
  - $GHG_{j,t}$ = methane emissions per dollar of production in country j
  - D = BSE dummy

4. Data and Estimation

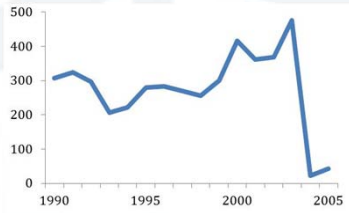
- Most of data are collected from FAO STAT. Distance is collected from CEPII (Cenre d'Etudes prospectives et d'Informations internationals). GHG emission data is collected from the Emission Database for Global Atmospheric Research (EDGAR), European Commission.
  - Compiled a data set of 23 countries during 1991 to 2005.
- We ran three models, OLS, random effects and fixed effects model.
  - F tests in three models support the overall significance of estimation.
  - The Hausman test shows that random effects model is preferred.
  - All the coefficients in the equation have expected signs.

5. Discussion

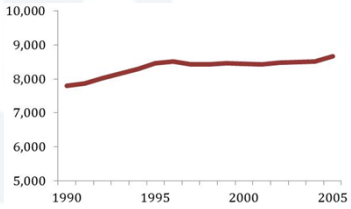
- The proxy variable for the transportation cost, distance, has negative and significant coefficients
- Based on estimation results, US cattle meat export is more sensitive to US production itself than consumption in country j.
- The coefficient for GHG emission in US cattle sector is estimated as around 15 (positive and significant). If GHG emission is reduced by 1% the cattle meat export would decrease by 15% (log-log specification).
  - The regulation of GHG emission in cattle industry may have the adverse impact on US cattle meat export.
  - Additional production cost imposed on US cattle meat industry decreases its trade competitiveness in the international market.

Explanatory Variables	OLS	Random Effect[2]	Fixed Effect
$\ln(DIST_{US,j})$	−0.809 (0.00)*	−0.842 (0.04)*	Omitted
$\ln(PROD_{j,t})$	14.659 (0.04)*	15.180 (0.01)*	14.789 (0.01)*
$\ln(CNSMP_{j,t})$	0.339 (0.01)*	0.129 (0.70)	−2.030 (0.15)
$\ln(GHG_{US,t})$	14.101 (0.05)**	14.730 (0.01)*	14.807 (0.01)*
$\ln(GHG_{j,t})$	−0.405 (0.06)**	−0.192 (0.79)	−1.815 (0.27)
BSE Dummy	−3.155 (0.00)*	−3.057 (0.00)*	−2.861 (0.00)*
Constant	−122.163 (0.06)**	−124.867 (0.02)*	−114.025 (0.01)*
Sigma_u		2.160	3.905
Sigma_e		2.156	2.156
R^2	0.176	0.158	0.169
Test for heteroskedasticity (P-value)[1]	0.818		

P-values are in parentheses (* and ** indicate significance at 5% and 10%, respectively)
[1] Breusch-Pagan / Cook-Weisberg test for heteroskedasticity: H_0: constant variance
[2] Random effect u_i - N(0, sigma_u)



← Value of US cattle meat export



← US methane emission

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